# TECHNICAL MEMORANDUM

Utah Coal Regulatory Program

June 4, 2004

CK

TO: Internal File

THRU: Daron R. Haddock, Permit Supervisor

FROM: Gregg A. Galecki, Environmental Scientist III/Hydrology

RE: Dugout Mine UPDES Mine Discharge, Canyon Fuel Company, LLC, Dugout Canyon Mine, C/007/0039

**SUMMARY:**

The following is an evaluation of the hydrologic regime of the Dugout Creek/Pace Creek/Grassy Trail Creek drainage system considering impacts due to mine discharge. The Dugout Canyon mine currently has a Utah Pollutant Discharge Elimination System (UPDES) General Permit that has allowable limits of various water quality parameters. The two analysis of discussion focus on mine discharges in excess of 2,000 pounds (1-ton) of Total Dissolved Solids (TDS) and Total Iron (T-Fe) concentrations in excess of 1 mg/l as a daily maximum. Due to mining conditions encountered initially in August 2002, and almost regularly since April 2003, the mine has had difficulties in not exceeding their allowable limits for TDS and occasionally for T-Fe.

Canyon Fuel Company has been working in conjunction with the Utah Division of Water Quality (UDWQ) to try to mitigate the situation for almost a year. In April 2004, Dugout Canyon Mine applied for an Individual Discharge permit requesting an increase in the 1-ton/day TDS due to the interception of groundwater. The report indicated the Mine was intercepting groundwater that would otherwise naturally report to Dugout Creek through the alluvium. The request to increase the Mine's allowable TDS limit based on the report was denied by DWQ. The Division of Oil, Gas, & Mining continues to monitor the situation and assess the downstream impacts. The additional water continues to be used beneficially by filling stock ponds and irrigating crops. The rancher downstream has recently disced two (2) additional fields in preparation of planting additional alfalfa.

The Division's current evaluation has determined that the water quality of the discharges is not in excess of anticipated/baseline concentrations that would be normally seen in the region. Water quality data collected in April 2004 suggests any variation between the discharge and receiving waters of Dugout creek are buffered/mitigated within 1/3-mile downstream of the mine. The additional water provided by the mine discharge is having a positive offsite impact by providing water to wildlife, livestock, and crops.

**History:**

Historic mining activities began in the area in the 1920's and continued through the mid 1960's, leaving abandoned workings in the Gilson seam on both the west and east side of the canyon. From the beginning of the Mine Operation in 1998, Dugout Mine has not had any problems with mine discharge. No mine water was discharged from the mine prior to 2002. However, the original Probable Hydrologic Consequence (PHC) of the mine did indicate that there was a possibility of needing to discharge water from the mine in the future.

In August 2002, the Mine discovered excessive amounts of water were stored in abandoned underground workings located dangerously close to the current operation. MSHA required an emergency dewatering of the abandoned Gilson seam workings – in the past referred to as the Knight Ideal Mine (old Gilson east workings), located on the east side of the surface facility. During the emergency dewatering project, discharges of the 'Old Knight' workings ranged from 1565 to 1750 gpm, with Total Iron concentrations of 4.5 to 5.0 mg/l and TDS concentrations of approximately 1400 mg/l. Due to the large volumes of water, the TDS loading of the stream ranged from 27,000 to 30,000 lbs/day. As illustrated in an evaluation conducted in 2002, the impacts downstream were seen as favorable due to the conditions existing in the receiving streams and the drought conditions that have been experienced in the area since 1998. Since August 2002 discharges from the old Gilson east workings are estimated at an average of 45 gpm with increases during spring runoff.

**Recent Discharges**

Currently, water discharged from the mine consists of approximately 45 gpm of high total Iron / low TDS water from the 'Old Knight' mine workings on the east side of the canyon, and varying amounts of low T- Fe / high TDS water reporting through the gob and inflows within the current mine workings on the west side of the canyon. The two are combined to form UPDES 001A from the Dugout Mine (Photo 7A).

Figure 1 illustrates the monthly discharges that have been documented since March 2002, prior to that date the mine had never discharged. The 2,000 lb/day General Permit limit is outlined in red. During 2002-2003 mine discharges have averaged 86 gpm with TDS concentrations of 1742 mg/l. The daily load of TDS for this time period was approximately 1800 lbs/day, roughly 90 percent of the General Permit allowance. The General Permit was exceeded seven (7) times during the 24 month period, the primary exceedances occurring during the emergency mine dewatering.

Figure 2 is water quality information of stream monitoring site G-10 from the neighboring Soldier Canyon Mine. It has been provided to demonstrate anticipated/baseline data for streams flowing through the upper portions of the Mancos shale. Due to the ephemeral nature of streams in the area, flows range from 0 to 580 gpm. Documentation of flows from G-10 are not as tightly regulated as the Dugout discharge permit and additional flows were likely not documented. However for the 11 samples collected at the site, concentrations of TDS

averaged 1388 mg/l. The event where the flow was 580 gpm natural TDS loading in the stream was 3778 lbs./day indicating TDS loading in excess of 2000 lbs/day is not unexpected. The average TDS concentration of 1742 mg/l at the mine discharge is roughly a 20 percent increase. The TDS values for the samples collected in April 2004 down Dugout Creek averaged 1800 mg/l are also on the graph in blue.

Figure 3 illustrates a comparison of the TDS loading of the addition of the mine discharge and the neighboring creeks. With the exception of a few events, the majority of discharge events are not uncommon for the area. It is noted that the flows are proportionally low for the amount of loading. This possibly indicates that any affects of the additional TDS will be observed close to the mine due to the limited carrying capacity of the Dugout Creek based on low flows.

**2004 Investigation:**

As part of evaluating the offsite impacts, Dugout Mine personnel has collected flows and water analysis downstream of the mine site down to the first 'perennial' stream, which is Grassy Trail Creek. Map 1 illustrates both the location of Grassy Trail Creek in relationship to the Mine, and also the locations of 'offsite impact evaluation (OIE) sites. Numbers in Map1 identify the location of OIE sites and corresponding photos 1 – 7B. The numbers in parenthesis are the flow and TDS (mg/l) concentrations of samples collected 20-21 April 2004 (Table 3 provides water quality analysis). The figure and photos are presented to provide a perspective of 1) the distance the discharge needs to travel to reach the first designated perennial stream, 2) the conditions that exist in the receiving streams (Dugout, Pace, and Grassy Trail), and 3) how the discharges are being put to beneficial use. Photos were taken by Division personnel on 29Apr04, as part of the current investigation. Discharges for the day were approximately 75 gpm.

Close observations of the 20-21Apr04 data support general observations noted in the past. Primary observations are: 1) Dugout Creek is a gaining stream as it leaves the mine area until it reaches the Waterfall; 2) Water quality becomes poorer as is it proceeds through the Mancos shale; and 3) any adverse water quality introduced to the creek from the discharge drops out or is buffered by the streams natural chemistry. Information is not conclusive since only one set of samples was collected, and no baseline data on the stream exist. However, a discharge of 65 gpm with 2190 mg/l TDS and 0.29 mg/l of T-Fe was blended to 1780 mg/l TDS and 1.23 mg/l in a distance of approximately 1/3-mile downstream at the bridge crossing (OIE photo #6). At the First Road crossing, 2+ miles downstream (OIE photo #5) the flow of approximately 90 gpm had increased to 110 gpm, TDS remained constant at 1770 mg/l and T-Fe increased to 1.64 mg/l. Based on flow and changing water quality information, it appears any influence of the mine discharge is mitigated by the local geology by the time any flow reaches the Waterfall (OIE#4) located over 3 miles downstream. Photos OID #4 and #5 contrast the significant effects geology has on the area. The affects of the more resistant sedimentary rocks in the vicinity of OIE #5 are apparent.

The documented flows and water quality indicate the dynamic nature of Dugout Creek. The discharge of 65 gpm, no matter how consistent, would not reach Grassy Trail Creek located approximately 10-miles downstream. The flow would eventually be absorbed into the alluvium. Due to the excessively dry conditions that have been observed in the area, all available water is being use beneficially by a local rancher. The flow comparisons between OIE photo #3 and OIE photo #4 illustrate that all of the water that is produced in upper Dugout Creek (natural and outfall) is being put to beneficial use. Photos 3B and 3C show the alfalfa fields that are being irrigated and stock ponds that are also being filled to capacity. Photos 1A through 2 demonstrate the dry, ephemeral nature of lower Pace/Dugout Creek and Grassy Trail Creek. Photo 1A also illustrates the effects the current drought is having on perennial streams in the area. Livestock and poultry can satisfactorily consume water with TDS concentrations up to 2,999 mg/l; livestock can handle TDS concentrations up to 5,000 mg/l according to information provided in the Colorado River Basin Salinity forum. Agricultural concentration limits for TDS are typically set at 1,200 – 1,500 mg/l but vegetation in the area has apparently adapted. The local rancher has disced two (2) additional fields in preparation for additional alfalfa.

## 2004 Discharges:

Exceedances of the 2000 lb/day limit were observed in February and April 2004 that were concerning. Concentrations of TDS were 8,475 mg/l and 6,322 mg/l, respectively. The February discharge was necessary due to a longwall move where the inflows could not be used underground and additional dissolution of the floor material occurred. An apparent phenomenon occurs when there is a significant change in the sump reservoir size. When areas that were flooded, pumped dry, then flooded again the second flooding has a tendency to increase TDS through the dissolution of additional sulfides. The April discharge was apparently influenced with the combination of the stabilizing of the sump reservoir size and increased flow through the gob due to spring runoff. An exceedance was documented in May 2004 with a flow of 300 gpm and TDS concentration 2110 mg/l, totaling 7600 lbs/day TDS.

## RECOMMENDATIONS:

Continue to monitor the situation from a water quality perspective and the potential affects to vegetation located in the riparian areas of Dugout Creek. Look for evidence of excessive loading in Dugout Creek, and detrimental affects to irrigated fields and stock. Continue to keep informed on the progress/changes to the UPDES permit issued by UDWQ.

Attachments:
Map (11x17)
Data Tables: 1-3
Graphs: UPDES 001 Discharge into Dugout Creek
TDS Concentration Comparison
Flow vs. TDS Loading Comparison
Photos:1A- 7B (14 total photos)
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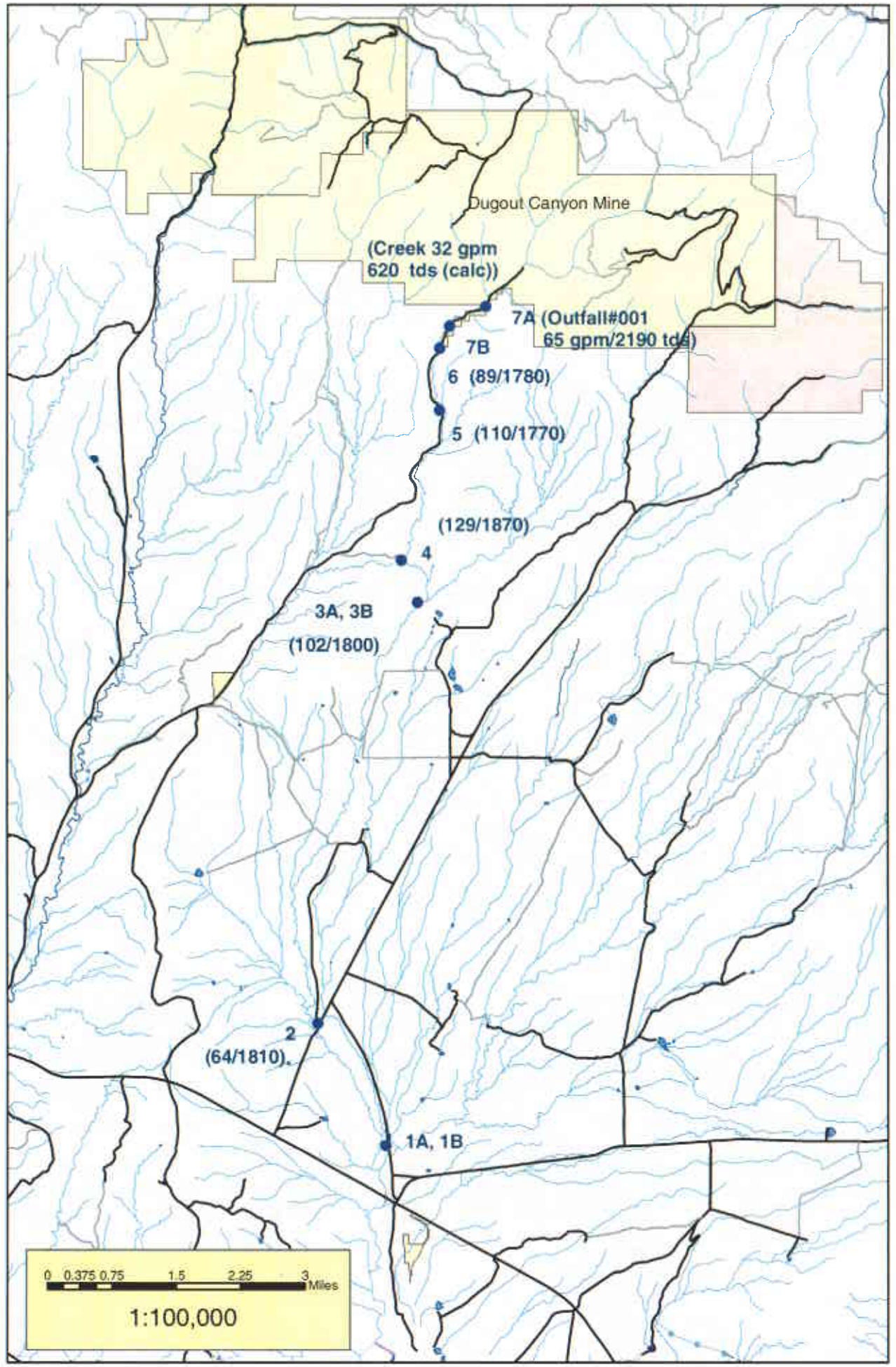
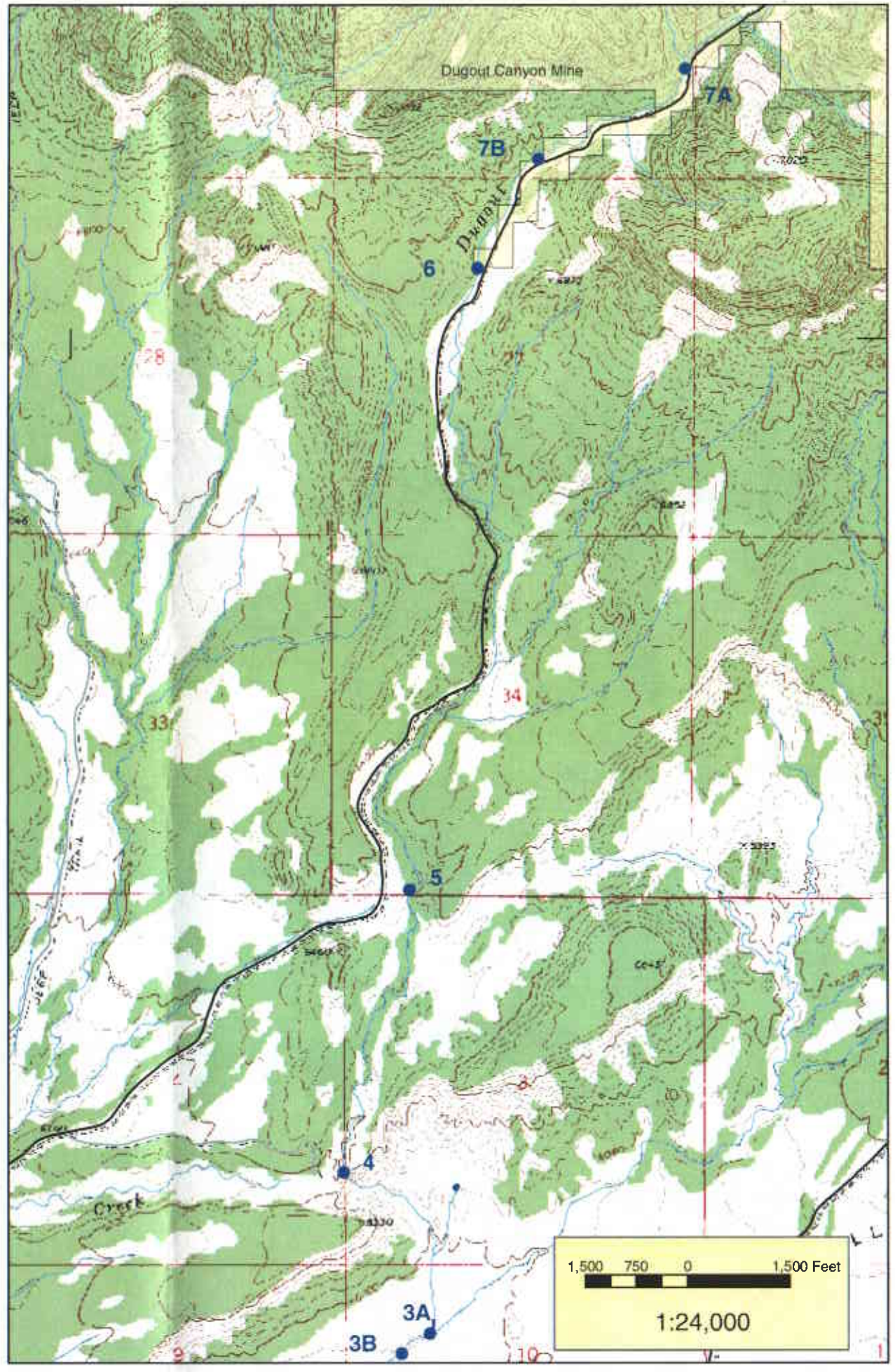
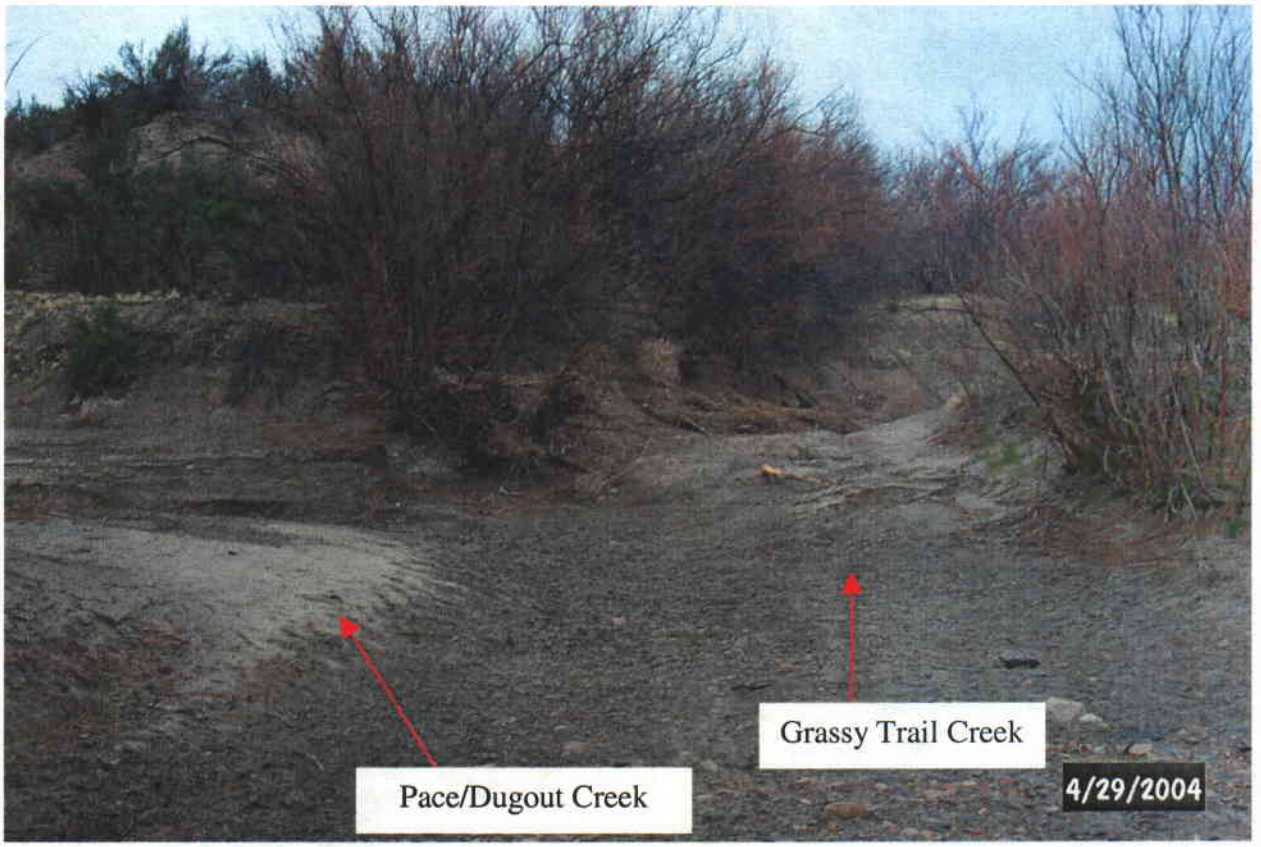



# Dugout Canyon Mine UPDES Down Stream Impact Evaluation Sites

N

June 1, 2004

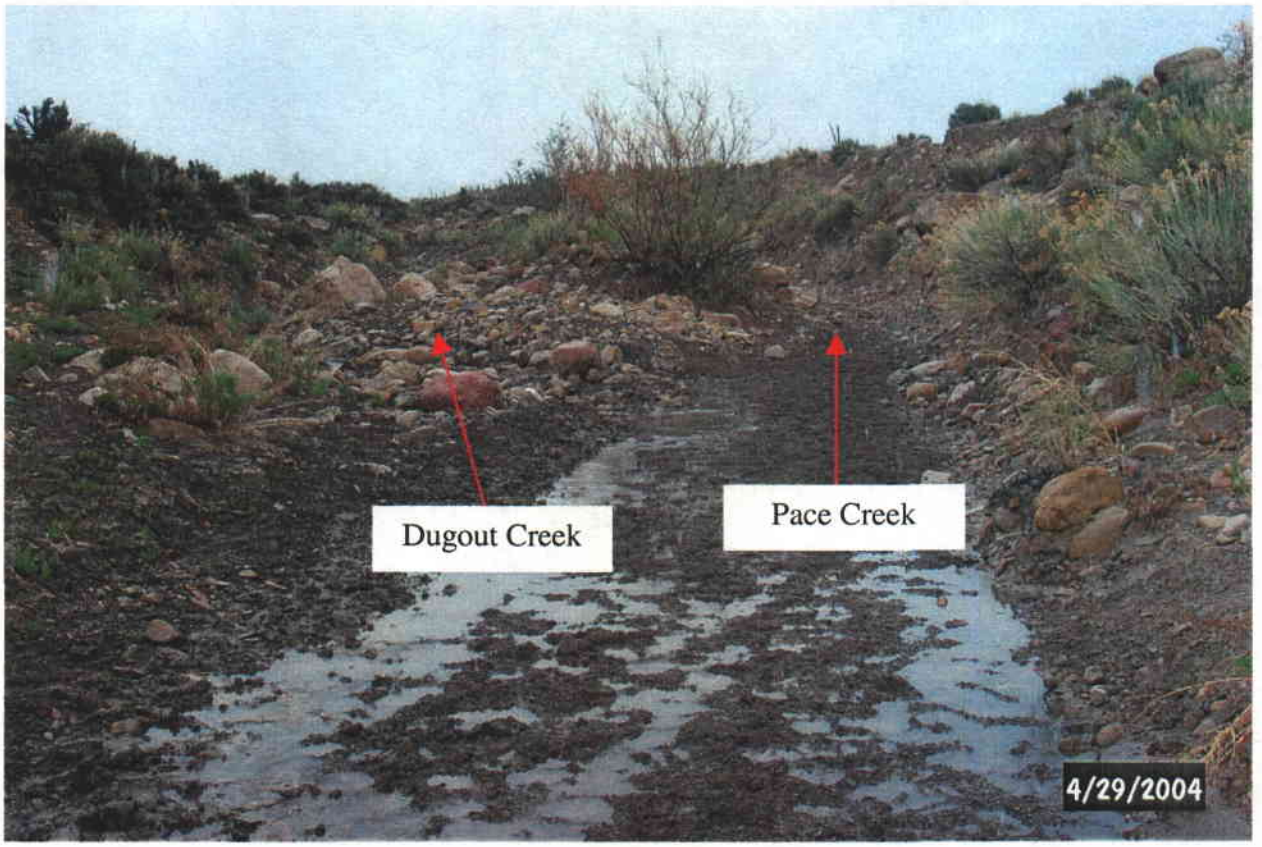



**1A**


**1B**

**Pace/Dugout at Grassy Trail**


**2**
**Clark Valley Road Crossing**
**(flows 1-2 times per year)**




**3A**
**Confluence of Dugout and Pace Creek**

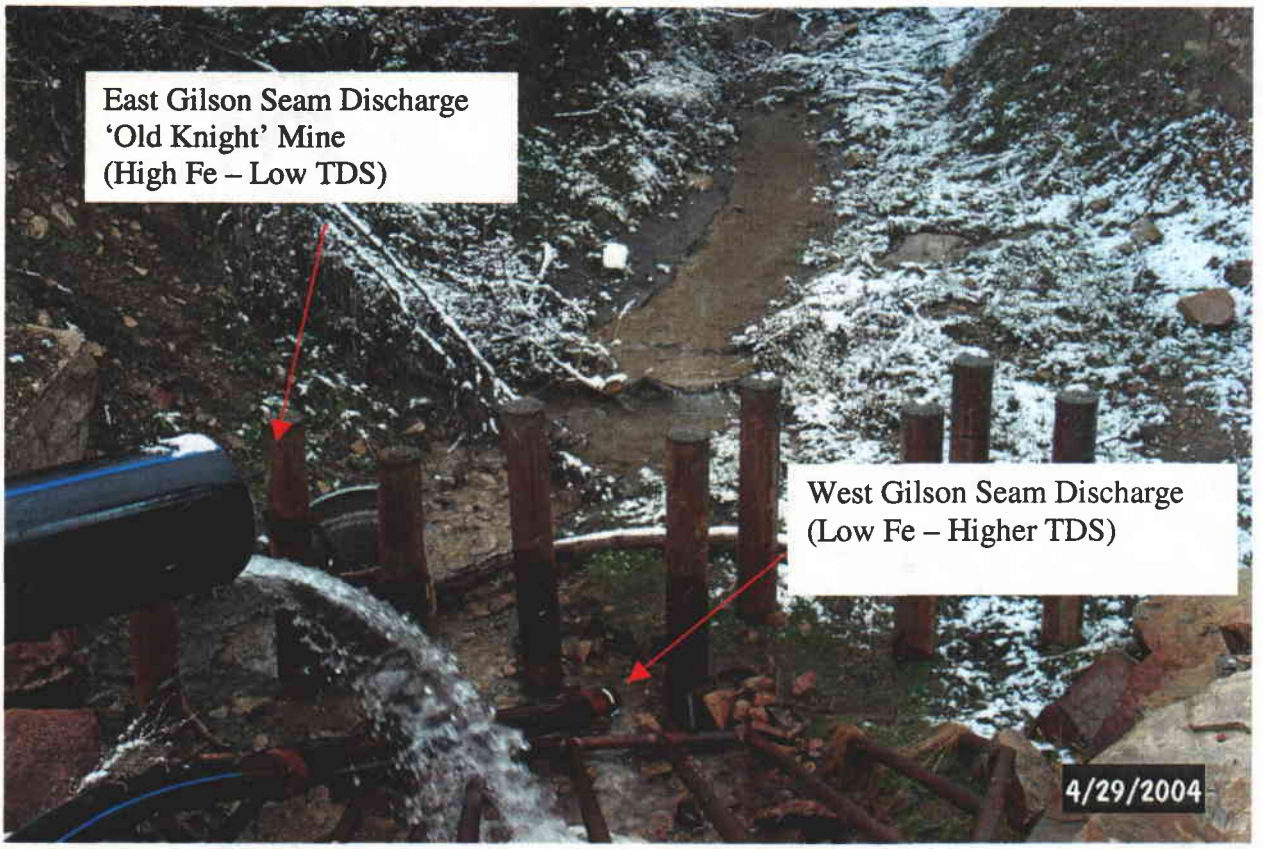

**3B**
**Alfalfa Field Irrigated by Pace/Dugout Creeks**


**3C**

**Stock pond filled with Dugout/Pace Creek**


**4**

**Waterfall Through Mancos Shale**




**7A**
**Dugout Upstream of Mine**


5

**First Road Crossing Above Waterfall**


5

**June Photo for Vegetation comparison**

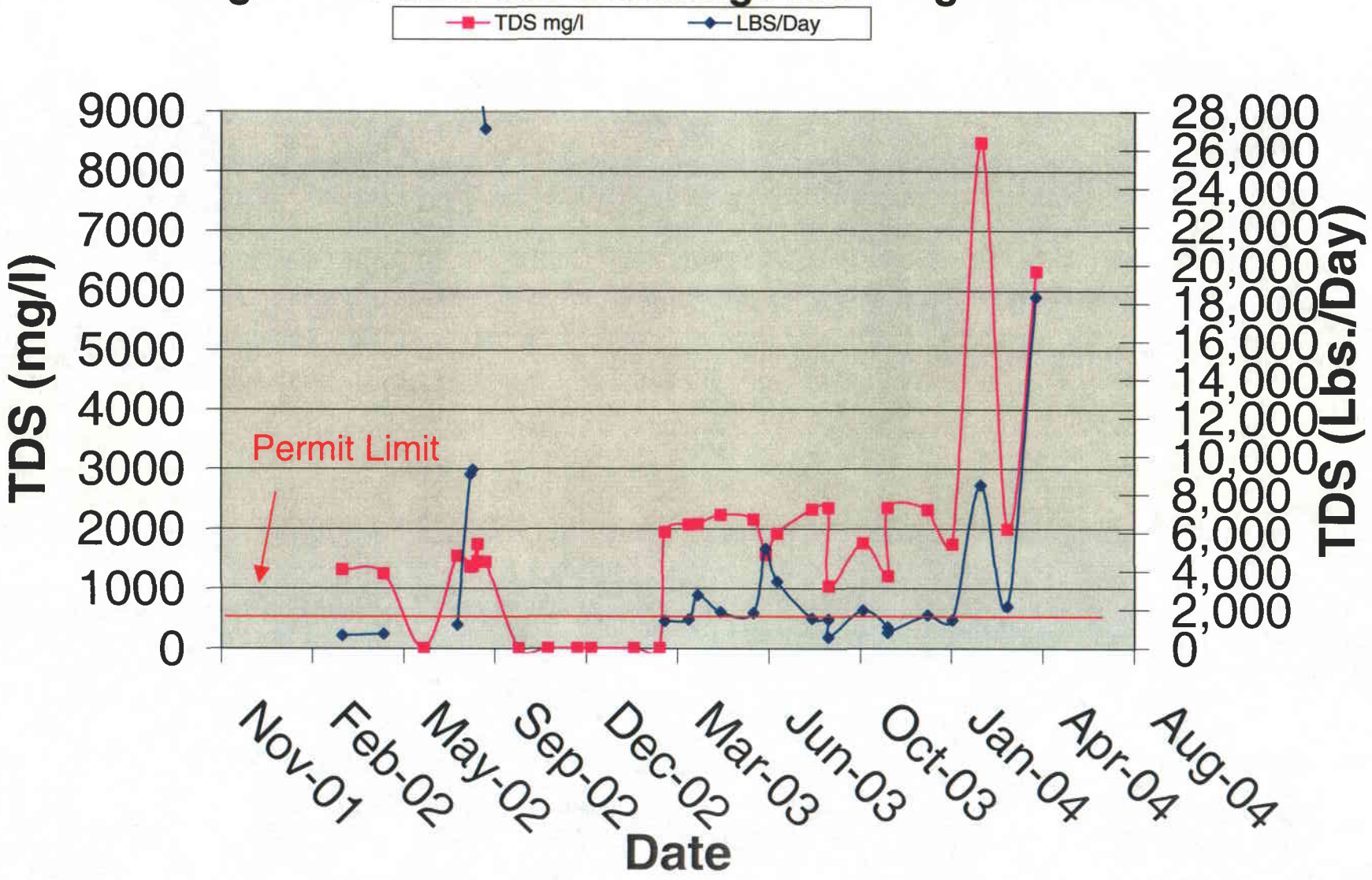

**6A**
**Bridge 1/3 Mile Below Mine Site**


**6A**
**June Photo for Vegetation comparison**

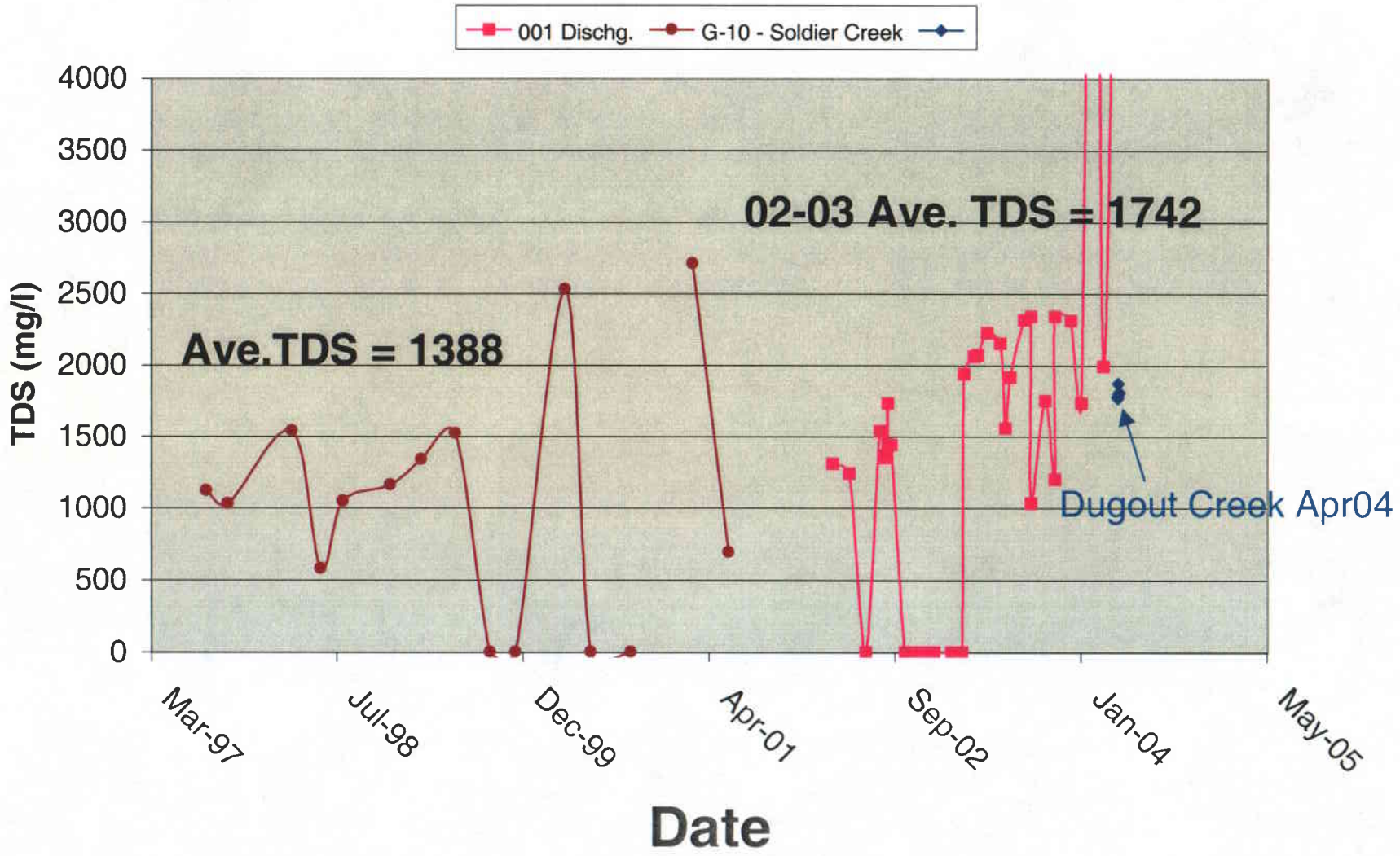

**7B**
**Below Mine**


**7B**
**June Photo for Vegetation comparison**

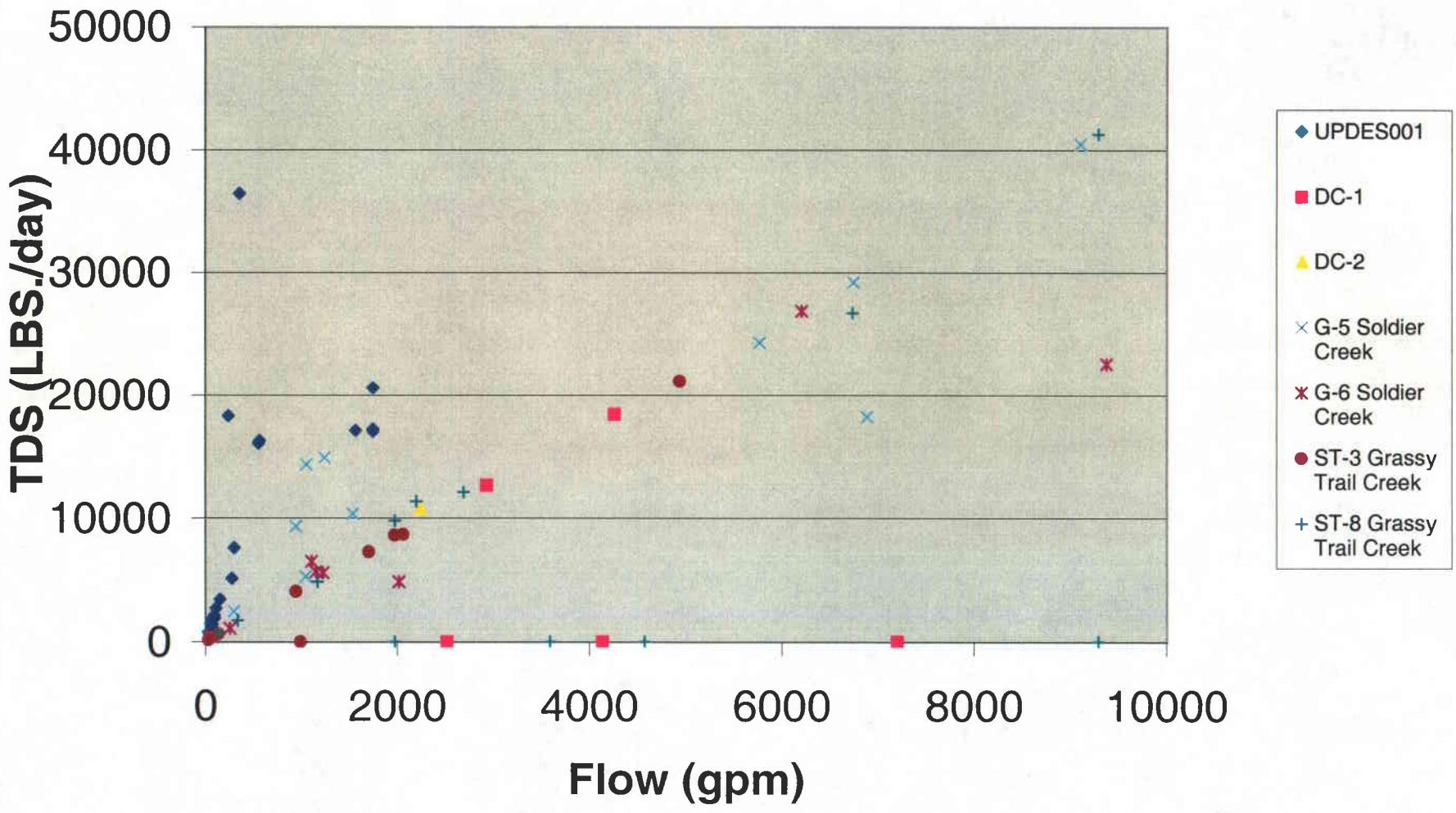
## Fig. 1 - UPDES 001 Discharge into Dugout Creek



# Figure 2 - TDS Concentration Comparison



# Fig. 3 - Flow vs TDS Loading Comparison



## Table 1

| MINE | SITE NAME | SITE DESCRIPTION | DATE | GPM | TDS mg/l | T-Fe mg/l | Lbs./Day |
|---|---|---|---|---|---|---|---|
| DUGOUT | UTG040020-001 | Dugout Ck to Pace Cr | 04/15/2004 | 241 | 6322 | 0.42 | 18,310 |
| DUGOUT | UTG040020-001 | Dugout Ck to Pace Cr | 03/15/2004 | 90 | 1990 | 1.39 | 2152 |
| DUGOUT | UTG040020-001 | Dugout Ck to Pace Cr | 02/15/2004 | 358 | 8475 | 0.62 | 8475 |
| DUGOUT | UTG040020-001 | Dugout Ck to Pace Cr | 01/15/2004 | 69 | 1734 | 0.27 | 1438 |
| DUGOUT | UTG040020-001 | Dugout Ck to Pace Cr | 12/19/2003 | 62 | 2310 | 0.25 | 1721 |
| DUGOUT | UTG040020-001 | Dugout Ck to Pace Cr | 11/05/2003 | 28 | 2340 | 0.28 | 787 |
| DUGOUT | UTG040020-001 | Dugout Ck to Pace Cr | 11/05/2003 | 75 | 1200 | 1.5 | 1082 |
| DUGOUT | UTG040020-001 | Dugout Ck to Pace Cr | 10/09/2003 | 92 | 1750 | 0.82 | 1935 |
| DUGOUT | UTG040020-001 | Dugout Ck to Pace Cr | 09/01/2003 | 44 | 1033 | 0.949 | 546 |
| DUGOUT | UTG040020-001 | Dugout Ck to Pace Cr | 09/01/2003 | 52 | 2341 | 0.348 | 1463 |
| DUGOUT | UTG040020-001 | Dugout Ck to Pace Cr | 08/14/2003 | 55 | 2316 | 0.431 | 1531 |
| DUGOUT | UTG040020-001 | Dugout Ck to Pace Cr | 07/07/2003 | 150 | 1915 | 4.69 | 3452 |
| DUGOUT | UTG040020-001 | Dugout Ck to Pace Cr | 06/25/2003 | 275 | 1558 | 6.94 | 5149 |
| DUGOUT | UTG040020-001 | Dugout Ck to Pace Cr | 06/11/2003 | 70 | 2150 | 0.264 | 1808 |
| DUGOUT | UTG040020-001 | Dugout Ck to Pace Cr | 05/06/2003 | 70 | 2224 | 0.105 | 1871 |
| DUGOUT | UTG040020-001 | Dugout Ck to Pace Cr | 04/11/2003 | 110 | 2071 | 0.189 | 2738 |
| DUGOUT | UTG040020-001 | Dugout Ck to Pace Cr | 04/01/2003 | 60 | 2061 | 0.176 | 1486 |
| DUGOUT | UTG040020-001 | Dugout Ck to Pace Cr | 03/06/2003 | 60 | 1940 | 0.12 | 1399 |
| DUGOUT | UTG040020-001 | Dugout Ck to Pace Cr | 02/28/2003 | 0 | | | |
| DUGOUT | UTG040020-001 | Dugout Ck to Pace Cr | 01/31/2003 | 0 | | | |
| DUGOUT | UTG040020-001 | Dugout Ck to Pace Cr | 12/15/2002 | 0 | | | |
| DUGOUT | UTG040020-001 | Dugout Ck to Pace Cr | 11/30/2002 | 0 | | | |
| DUGOUT | UTG040020-001 | Dugout Ck to Pace Cr | 10/29/2002 | 0 | | | |
| DUGOUT | UTG040020-001 | Dugout Ck to Pace Cr | 09/27/2002 | 0 | | | |
| DUGOUT | UTG040020-001 | Dugout Ck to Pace Cr | 08/22/2002 | 1565 | 1440 | 5 | 27083 |
| DUGOUT | UTG040020-001 | Dugout Ck to Pace Cr | 08/13/2002 | 1750 | 1434 | 4.5 | 30159 |
| DUGOUT | UTG040020-001 | Dugout Ck to Pace Cr | 08/13/2002 | | 1449 | 4.5 | |
| DUGOUT | UTG040020-001 | Dugout Ck to Pace Cr | 08/13/2002 | | 1734 | 0.4 | |
| DUGOUT | UTG040020-001 | Dugout Ck to Pace Cr | 08/08/2002 | 564 | 1370 | 4.9 | 9286 |
| DUGOUT | UTG040020-001 | Dugout Ck to Pace Cr | 08/05/2002 | 555 | 1352 | < .01 | 9018 |
| DUGOUT | UTG040020-001 | Dugout Ck to Pace Cr | 07/22/2002 | 65 | 1540 | | 1202 |
| DUGOUT | UTG040020-001 | Dugout Ck to Pace Cr | 06/15/2002 | 0 | | | |
| DUGOUT | UTG040020-001 | Dugout Ck to Pace Cr | 05/02/2002 | 49.24 | 1240 | 0.27 | 730 |
| DUGOUT | UTG040020-001 | Dugout Ck to Pace Cr | 03/18/2002 | 40.625 | 1310 | | 645 |
| DUGOUT | UTG040020-001 | Dugout Ck to Pace Cr | 02/15/2002 | 0 | | | |
| DUGOUT | UTG040020-001 | Dugout Ck to Pace Cr | 01/15/2002 | 0 | | | |

## Table 2

| MINE | SITE NAME | SITE DESCRIPTION | DATE | GPM | TDS mg/l | T-Fe mg/l | Lbs./Day |
|---|---|---|---|---|---|---|---|
| SOLDIER | G-10 | Stream | 03/26/2003 | 0 | | | |
| SOLDIER | G-10 | Stream | 10/16/2002 | 0 | | | |
| SOLDIER | G-10 | Stream | 07/16/2002 | 0 | | | |
| SOLDIER | G-10 | Stream | 04/10/2002 | 0 | | | |
| SOLDIER | G-10 | Stream | 03/19/2002 | 0 | | | |
| SOLDIER | G-10 | Stream | 12/10/2001 | No Access | Ice/Snow | | |
| SOLDIER | G-10 | Stream | 09/24/2001 | 0 | | | |
| SOLDIER | G-10 | Stream | 06/12/2001 | 27.3 | 690 | | 226 |
| SOLDIER | G-10 | Stream | 03/07/2001 | 2.0 | 2710 | | 65 |
| SOLDIER | G-10 | Stream | 12/29/2000 | No Access | | | |
| SOLDIER | G-10 | Stream | 09/20/2000 | 0 | | | |
| SOLDIER | G-10 | Stream | 06/06/2000 | 20.6 | | | |
| SOLDIER | G-10 | Stream | 03/29/2000 | 8.0 | 2530 | | 243 |
| SOLDIER | G-10 | Stream | 11/17/1999 | 0 | | | |
| SOLDIER | G-10 | Stream | 09/08/1999 | 0 | | | |
| SOLDIER | G-10 | Stream | 06/08/1999 | 3.0 | 1520 | 0.26 | 55 |
| SOLDIER | G-10 | Stream | 03/08/1999 | 8.4 | 1340 | 0.38 | 135 |
| SOLDIER | G-10 | Stream | 12/14/1998 | | 1160 | 0.45 | |
| SOLDIER | G-10 | Stream | 08/10/1998 | 13.0 | 1050 | 0.08 | 164 |
| SOLDIER | G-10 | Stream | 06/11/1998 | 542 | 580 | 0.05 | 3778 |
| SOLDIER | G-10 | Stream | 03/25/1998 | 23.8 | 1540 | | 440 |
| SOLDIER | G-10 | Stream | 10/04/1997 | 18.0 | 1030 | | 223 |
| SOLDIER | G-10 | Stream | 08/07/1997 | 40.4 | 1120 | 0.11 | 544 |

# Table 3

Samples taken April 20 and 21, 2004 in a 24 hour period on Dugout Creek.

| Analysis | OutFall 01 | Bridge | 1st Road Crossing | Waterfall | Alfalfa Field Confluence | Concrete Crossing |
|---|---|---|---|---|---|---|
| Calcium | 229 | 179 | 174 | 171 | 166 | 155 |
| Dissolved Iron | - | 0.05 | 0.04 | 0.08 | U | 0.02 |
| Total Iron | 0.29 | 1.23 | 1.64 | 3.03 | 33.5 | 5.71 |
| Magnesium Dissolved | 215 | 171 | 172 | 178 | 176 | 173 |
| Manganese Dissolved | - | 0.026 | 0.022 | 0.013 | 0.006 | 0.011 |
| Potassium Dissolved | 21.3 | 15.6 | 14.1 | 14.6 | 13.7 | 13.4 |
| Sodium Dissolved | 106 | 85.9 | 86.8 | 92.1 | 98.2 | 101 |
| Bicarbonate | 275 | 258 | 259 | 246 | 265 | 244 |
| Total Alkalinity | 275 | 258 | 259 | 246 | 265 | 244 |
| Cation/Anion Balance | -0.9 | -1.4 | -2.4 | -2.0 | -3.5 | -3.3 |
| Chloride | 54 | 51 | 54 | 56 | 57 | 57 |
| TDS | 2190 | 1780 | 1770 | 1870 | 1800 | 1810 |
| TSS* | U | 74 | 86 | 168 | 2250 | 318 |
| Sulfate | 1330 | 1020 | 1030 | 1060 | 1070 | 1050 |

- =Not analyzed
U = Undetected
* = TSS was analyzed past holding time on all samples except the outfall sample.